CAAP Quarterly Report

Date of Report: April 16, 2020

Prepared for: *U.S. DOT Pipeline and Hazardous Materials Safety Administration*

Contract Number: 693JK31950006CAAP

Project Title:
AN AUTONOMOUS UAS INSPECTION PLATFORM FOR HIGH-EFFICIENCY 3D PIPELINE /ROUTE MODELING /CHANGE-DETECTION AND GAS LEAK DETECTION-LOCALIZATION

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For quarterly period ending: **3/31/2020**

Business and Activity Section

(a) Contract Activity

Contract modifications:
          No contract modification is expected at this point.

Discussion about materials purchased:

          A DJI Ronin-MX gimbal and accessories were purchased to mount the 10-lb thermal camera on the drone for inspecting above-ground pipelines and tanks.

(b) Status Update of Past Quarter Activities

High level summary of the work performed for the reporting period.

(c) Cost share activity

     The PI dedicated 0.2 FTE in this quarter to the project.

(d) *Progress by tasks/subtasks*

Task 1: Develop a prototype of pipeline/tank inspection data management and the integration module (PIDMIM). (20% completion)

Subtask 1.1. *Design and implement the proposed PIDMIM, which utilizes Google Maps as user interface to access, retrieve, and visualize inspection data (in image, point cloud, and text data formats).*

The completed part included the visualization platform identification, data retrieval and storage format, and pilot implementation and coding.

Task 2. Develop the quality-based 3D coverage path planning (CPP) algorithm*.*
Subtask 2.1. *Identify and investigate the appropriate parameters and their value ranges to balance the UAS inspection efficiency and photogrammetry model quality. Identify appropriate optimization algorithms for pipeline/tank 3D coverage path planning (CPP). (**100% completion**)*

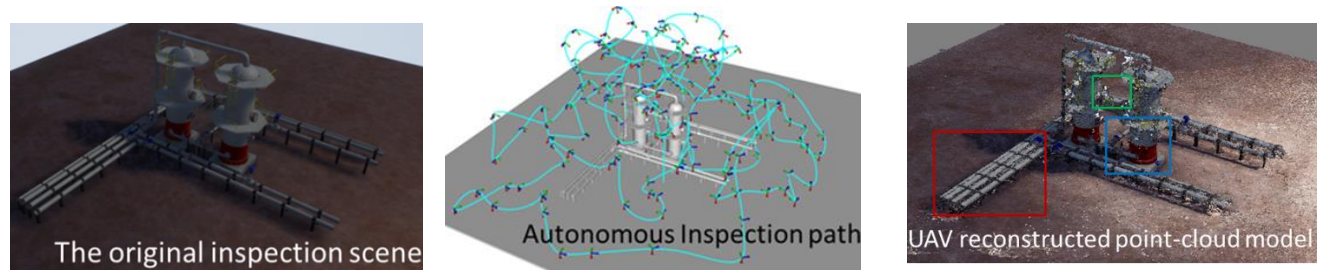This subtask was completed, and the outcomes (Fig 1 A, B, C) were presented in the 2020 R&D Forum.

Fig 1. A. hypothetical facility   B. calculated inspection path   C. 3D model reconstruction

Subtask 2.2. *Implement and test the developed 3D CPP algorithm through simulations and indoor/outdoor flight tests. (**50%**)*

Simulation-based implementation and tests were completed. Indoor/outdoor tests is to be completed in the next 2-3 quarters.

(e) ***Project Activities:***
1. The research team presented partial research outcomes of this quarter in the 2020 PHMSA R&D Forum at Washington D.C on February 19-20, 2020. (from right: Chongsheng Cheng, Gabriel Clark, Zhexiong Shang, and Zhigang Shen)
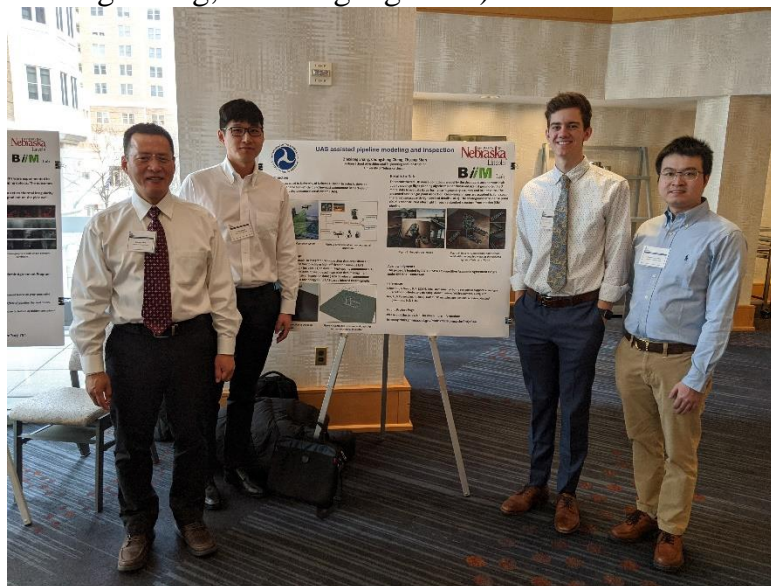
(f) **Future work**

In Quarter 3, the team will focus on task 3.

Task 3. Develop a 3D profile change identification and quantification (PCIQ) module
Subtask 3.1. Identify and evaluate the out-of-the-box photogrammetry software in terms of its capability and accuracy in processing a large inspection pipeline dataset and create demonstrative before-and-after 3D pipeline/route models.

Subtask 3.2. Develop a 3D profile change identification and quantification (PCIQ) module to allow automatic before-and-after event comparisons of 3D models to identify the change locations and change quantities. The changes can include land movement, third-party excavation, pipe displacement, scour erosion, etc.

References

N/A